The Office of Environment, Safety and Health and its Office of Nuclear and Facility Safety (NFS) publishes the Operating Experience Weekly Summary to promote safety throughout the Department of Energy (DOE) complex by encouraging feedback of operating experience and encouraging the exchange of information among DOE nuclear facilities.

The Weekly Summary should be processed as an external source of lessons-learned information as described in DOE-STD-7501-96, *Development of DOE Lessons Learned Programs*.

To issue the Weekly Summary in a timely manner, the Office of Operating Experience Analysis and Feedback (OEAF) relies on preliminary information such as daily operations reports, notification reports, and, time permitting, conversations with cognizant facility or DOE field office staff. If you have additional pertinent information or identify inaccurate statements in the summary, please bring this to the attention of Jim Snell, 301-903-4094, or Internet address jim.snell@hq.doe.gov, so we may issue a correction.

Readers are cautioned that review of the Weekly Summary should not be a substitute for a thorough review of the interim and final occurrence reports.

Operating Experience Weekly Summary 97-18

April 25 through May 1, 1997

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EVENTS

1. CRITICALITY SAFETY POSTING NOT FOLLOWED FOR GLOVEBOX

On April 21, 1997, at the Hanford Plutonium Finishing Plant, a surveillance operator discovered that the amount of fissile material stored in a container in a glovebox exceeded the amount listed on the criticality safety posting for the glovebox. The building emergency director verified that the material in the glovebox violated the posting but complied with the criticality-prevention specification. Managers at the plant classified the event as a procedure violation because workers failed to comply with the posting when they placed the material in the glovebox. All fissile material handling activities are presently restricted by the plant manager because workers violated procedures related to criticality safety in December 1996. Failure to comply with criticality safety postings can result in a reduced margin of safety for the facility. (ORPS Report RL--PHMC-PFP-1997-0019)

Investigators determined the workers placed the material in the glovebox in December 1996. At that time, the workers noticed that the mass quantity of fissile material inside the glovebox exceeded the quantity listed on the posting, so they checked with their manager. He determined that placing the new material in the glovebox would not violate the criticality-prevention specification. The workers intended to change the posting after they moved the additional fissile material into the glovebox, but the posting was never changed.

The plant manager directed workers to take the following corrective actions.

- Restrict access to the glovebox until further notice.
- Repost the glovebox with the proper criticality safety limits.
- Inspect other gloveboxes to ensure posting compliance.

This event is related to an event reported by the Plutonium Finishing Plant manager on December 31, 1996. A solid waste operator discovered an isolated transport container that held an undetermined amount of hood waste approximately 2 feet from a fixed array wagon containing 167 grams of plutonium. The criticality-prevention specification general limit required a 3-foot minimum spacing between an undetermined amount of plutonium and quantities of plutonium greater than 100 grams. Operators roped off the area and posted it as a possible criticality infraction.

The plant manager led a critique of the December event and determined that incorrect use of procedures was the direct cause. The plant manager curtailed fissile material handling operations pending the development and implementation of a recovery plan. The focus of the recovery plan is that a sound procedure compliance culture is the foundation for good conduct of operations. (OEWS 97-02 and ORPS Report RL--PHMC-PFP-1996-0015)

Operating Experience and Feedback (OEAF) engineers reviewed the Occurrence Reporting and Processing System (ORPS) database and found that 170 of the 499 occurrence reports related to nuclear criticality safety were caused, in part, by procedure violations. Of the 18 events reported by the Richland office, 13 occurred at the Plutonium Finishing Plant. Figure 1-1 shows the nuclear criticality safety occurrence reports distributed by field office. This data indicated that almost 56 percent of the reports are from Rocky Flats. Rocky Flats facility representatives believe that reporting thresholds at

their site are lower than most DOE sites because Rocky Flats reports infractions in addition to violations. Reporting infractions is a conservative measure because they can be precursors to more significant events. Also, the large volume of material and differences in building standards may account for the numerous reports.

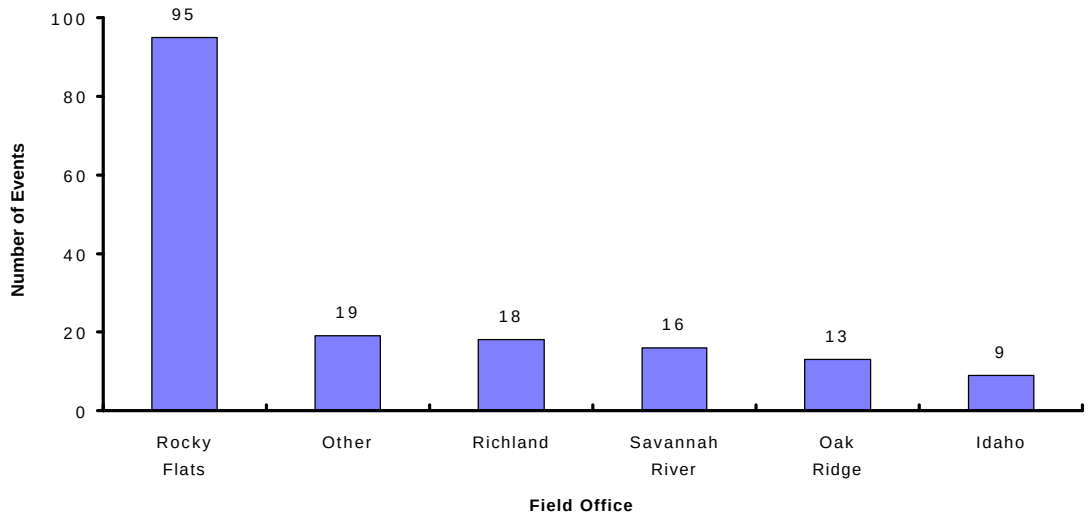

Figure 1-1. Distribution By Field Office Of Criticality Safety Events Caused By Procedure Violations[1]

These events illustrate the importance of procedure compliance to criticality safety. DOE 5480.24, *Nuclear Criticality Safety* (cancelled by DOE 420.1, but still in use at some facilities), provides direction for establishing nuclear criticality safety program requirements. The Order invokes several American Nuclear Society standards relating to basic program elements and control parameters for nuclear criticality safety programs. DOE 5480.19, *Guidelines for the Conduct of Operations Requirements for DOE Facilities*, chapter I, "Operations Organization and Administration," states that workers and their supervisors should be held accountable for operating performance. Personnel involved in significant or frequent violations of operating practices should be counseled, retrained, and disciplined, as appropriate. Chapter XVI, "Operations Procedures," states that procedures should be referenced during infrequent or unusual evolutions when the operator is not intimately familiar with the procedure requirements or when errors could cause significant adverse impact to the facility. DOE facility managers should ensure that all operators and supervisors are familiar with operating procedures and understand their purpose and use. This understanding is even more important when criticality safety issues are involved.

Failures such as human performance errors can be represented as failed barriers. According to the OEAF *Hazard and Barrier Analysis Guide*, barriers provide controls over hazards associated with a job. Barriers may be physical barriers, procedural or

[1]OEAF engineers reviewed the ORPS database for the nature of occurrence code 1A (Nuclear Criticality Safety) and found 499 reports. OEAF engineers reviewed the ORPS database for the nature of occurrence code 1A (Nuclear Criticality Safety) AND root cause code 3B (procedure not used or used incorrectly) OR direct cause code 3B (procedure not used or used incorrectly) OR contributing cause code 3B (procedure not used or used incorrectly) and found 170 reports.

administrative barriers, or human action. The reliability of barriers is important in preventing undesirable events such as nuclear criticality incidents. The reliability of a barrier is determined by its ability to resist failure. Barriers can be imposed in parallel to provide defense-in-depth and to increase the margin of safety. Postings are designed to improve the reliability of the human action barrier by enhancing human performance. Failure to properly post fissile materials can lower the reliability of the human action barrier and lower the margin of safety. The *Hazard and Barrier Analysis Guide* provides a detailed analysis for selecting optimum barriers, including a matrix that displays the effectiveness of different barriers in protecting against some common hazards.

A copy of the *Hazard and Barrier Analysis Guide* is available from Jim Snell, (301) 903-4094. Managers and supervisors should review the guide and incorporate hazard and barrier analyses in work and operation processes.

KEYWORDS: glovebox, storage, procedure

FUNCTIONAL AREAS: nuclear/criticality safety, procedures, materials handling/storage

2. IRRADIATED FUEL ELEMENT ACCIDENTALLY RELEASED IN FUEL TRANSFER CANAL

On April 27, 1997, at the Idaho National Engineering Laboratory Advanced Test Reactor, a fuel-handling tool accidentally released an irradiated fuel element while an operator was inserting it into a spent fuel grid. The event occurred in the fuel transfer canal, which was filled with water. The element came to rest in a horizontal position on top of the grid. The operator immediately lifted the element to a vertical position in accordance with the operating procedure. Operators used a camera to visually inspect the element and did not observe any damage. Investigators determined that the canal fuel-handling tool did not have a positive locking device. In July 1991, after a fuel element was dropped in the canal, the management and operating contractor implemented a requirement for a tool with a positive locking device. Investigators believe that during the transition to a new management and operating contractor, the requirements for the positive locking tool were not retained. Inadvertent release of irradiated fuel elements in the fuel transfer canal could damage potentially reusable fuel and fuel cladding and result in the release of fission gases that could expose personnel to airborne contamination. (ORPS Report ID--LITC-ATR-1997-0009)

Investigators determined that the previous management and operating contractor established the requirement for a tool with a positive locking device after an irradiated fuel element was accidentally released from the canal fuel-handling tool on May 16, 1991. Investigators also determined the cause of that event was inadequately designed fuel-handling tools. The design allowed the tools to activate inadvertently or to work open while holding fuel elements. As a corrective action, engineers designed new tools with positive locking devices. Facility personnel delineated the requirements for the new positive locking devices in a letter and in the facility-specific portion of the conduct of operations manual. The fuel-handling procedures were never changed to require the use of the new tools. (ORPS REPORT ID--EGG-ATR-1991-1005)

When Idaho National Engineering Laboratory changed management and operating contractors, neither the letter requiring a new tool with a positive locking device nor the facility-specific portion of the conduct of operations manual was retained. Operators used the new tool until it recently broke. Because they were unaware of the need for the new

tool and the procedure did not require them to use it, the operators used the old tool without the positive locking device.

Investigators verified that the release of an irradiated fuel element to a horizontal position is an analyzed event. The technical specifications prohibit operators from handling fuel until the reactor has been shutdown for a minimum time to allow for cooling. This requirement ensures adequate heat transfer and prevents thermal damage to structures if the released fuel element lands in a horizontal position. Operators followed this technical specification requirement before they began to unload fuel from the reactor.

Operating Experience and Feedback (OEAF) engineers reviewed the Occurrence Reporting and Processing System (ORPS) database for events caused by inadequate procedures and found 1,573 events. A review of the discovery dates for these events shows an improving trend since the beginning of 1994. Figure 2-1 shows the trend of events caused by lack of procedures DOE-wide.

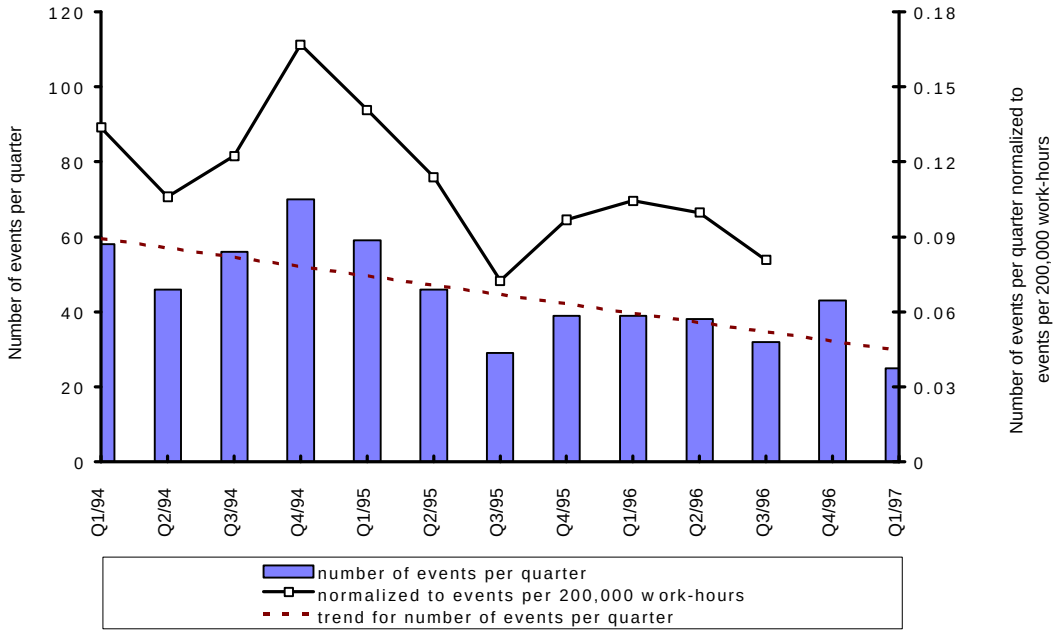

Figure 2-1. Trend of Lack of Procedure Events - First Quarter 1994 to Present[1]

This event illustrates the importance of retaining and proceduralizing information vital to safe and efficient operations. This is essential in this era of changing management and integrating contractors and loss of workforce knowledge and experience because of attrition and downsizing. This event could have been prevented if the requirement for a positive locking device had been included in the fuel-handling procedures. DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities*, section XVI, states that

[1]OEAF engineers reviewed the ORPS database for the direct cause code 2a (Defective or Inadequate Procedure) and found 1,558 Reports describing 1,573 events. The normalization data is presented only through third quarter 1996 because of the delay in reporting work-hour information DOE-wide.

the methods for disseminating operational information include procedures, operator orders, and operator aid postings. The Order also states that operations procedures should provide appropriate direction to ensure that the facility is operated within its design basis and should be used effectively to support safe operations of the facility.

DOE-STD-1073-93-Pt.1 and 2, *Guide for Operational Configuration Management Program*, discusses the control of changes that can lead to temporary or permanent changes in design and operating requirements, facility configuration, or facility documentation. The standard discusses identifying changes, conducting technical and management reviews, and implementing and documenting changes. Change management is the process of maintaining the configuration of safety requirements, procedures, and controls in agreement with the mission and facility design configuration. DOE facility managers should ensure that operations and maintenance personnel are aware of the requirements in Order 5480.19 and DOE-STD-1073-93-Pt.1 and 2.

KEYWORDS: fuel assembly, operations, transfer, procedure

FUNCTIONAL AREAS: operations, management

3. FACILITY MODIFICATIONS AFFECT AUDIBILITY OF CRITICALITY ALARMS

On April 25, 1997, at the Savannah River Site, test personnel discovered that nuclear incident monitor bells did not meet audibility requirements for some areas within the evacuation zones. Investigators subsequently determined that, over a period of time, facility modifications affected the audibility of the bells. Previous methods of audibility testing did not reveal that the bells were inaudible in some areas. The facility manager declared a potential inadequacy in the authorization basis for nuclear incident monitor bell testing because alignment was not maintained between the facility configuration and the audibility requirements. This event is significant because facility modifications were not evaluated for impact on a system designed to alert personnel of a criticality. (ORPS Report SR--WSRC-FBLINE-1997-0016)

Previous test procedures verified only that the bells were audible above background at specific locations within facility evacuation zones at a distance of 10 feet from the bell. DOE facility representatives questioned the validity of the audibility test when they learned that floor markers identifying the location for test measurements were no longer visible (Weekly Summary 97-14; ORPS Report SR--WSRC-SEPGEN-1997-0001). As a result, engineers re-evaluated the evacuation zones and revised the test procedures to verify that audible bells or other means are in place to ensure full evacuation of the zones upon activation of the alarm system.

When test personnel used the revised procedure, they discovered 42 locations where the bells were not audible above background noise. Facility personnel determined that facility modifications had introduced barriers (walls and doors) that impaired audibility and that new equipment had increased background noise levels. The facility manager declared the nuclear incident monitor bells inoperable and stopped fissile material movement in affected areas. He is developing temporary compensatory measures that will remain in place until permanent measures are implemented. These compensatory measures include relocating noise-generating equipment to new locations, replacing false-ceiling tiles with egg-crate units to increase sound levels of exiting bells, removing or propping open doors, having standby operators to alert personnel entering affected areas of alarms,

and restricting access. Long-term corrective actions include installing additional bells and calculating radiation areas using new, up-to-date, source terms.

NFS reported events where modifications affected facility operations and safety systems in Weekly Summaries 97-13, 97-07, 96-47, and 96-04.

- Weekly Summary 96-04 reported that on January 19, 1996, at Hanford, technicians found the decibel level of criticality alarm system horns in a classroom were too low. Investigators determined that personnel converted a storage room into a classroom and engineers had not considered audibility requirements when they changed the classification of the room. (ORPS Report RL--WHC-PFP-1996-0004)

- Weekly Summary 97-07 reported that on January 25, 1997, at the Oak Ridge Y-12 Site, a quarterly test of the criticality accident alarm system indicated that alarms were not audible while processing equipment was operating. Investigators determined that new equipment had been installed that changed the baseline decibel levels. (ORPS Report ORO--LMES-Y12SITE-1997-0008)

- Weekly Summary 97-13 reported that on March 24, 1997, at the Paducah Gaseous Diffusion Plant, fire department inspectors discovered improperly oriented sprinkler heads, areas without adequate coverage, and an improperly located sprinkler system. Investigators determined that structural changes were performed at the facility after the installation of the fire sprinkler system. (NRC Event Report Number 31972, 32002, and 32012)

- Weekly Summary 96-47 reported that on November 12, 1996, at the Rocky Flats Environmental Technology Site, engineers discovered that differential pressures between two rooms could not be read on pressure-differential indicating controllers and damper failures could cause unanalyzed flow in three rooms. Investigators determined that facility modifications made before 1990 resulted in obstructed flow paths between the rooms. (ORPS Report RFO--KHLL-771OPS-1996-0179)

These events illustrate the importance of thorough technical reviews of modifications and a disciplined configuration management program. Proposed modifications to a system need to be thoroughly reviewed for impact on the design basis and how they could affect existing facility systems and processes. As seen in these events, facility modifications affected audibility of alarm systems, fire protection system operation, and ventilation flow used to control the spread of contamination. Facility managers should ensure all personnel are made aware of the need for detailed modification reviews and a stringent configuration management change control process.

DOE-STD-1073-93, *Guide for Operational Configuration Management Program, Including the Adjunct Programs of Design Reconstitution and Material Condition and Aging Management, Parts 1 and 2,* addresses modification technical reviews as part of the change control element. Section 1.3.4.2 of the standard recommends that changes be reviewed and approved by the design authority before implementation. The section states that these reviews should be used to evaluate safety, environmental, and mission impacts and to determine post-implementation acceptance criteria. The standard also discusses the control of modifications that can lead to temporary or permanent changes in design requirements, facility configuration, or facility documentation. The standard discusses identifying changes, conducting technical and management reviews, and implementing and documenting changes.

ANSI/ANS-8.3, *Criticality Accident Alarm System*, provides direction for establishing and maintaining criticality and nuclear incident alarm systems. Section 4.4.1 requires quarterly checks of audible alarms in areas that may require personnel evacuation. The standard states that alarms are for immediate evacuation and shall be of sufficient volume and coverage to be heard in all areas to be evacuated.

KEYWORDS: criticality safety, surveillance, test, procedure, modification control

FUNCTIONAL AREAS: nuclear/criticality safety, surveillance, procedures, configuration control, emergency planning

4. REFRIGERATION UNIT FAILURE CAUSES POTENTIAL EXPLOSIVE HAZARD

On April 25, 1997, the facility manager at Lawrence Berkeley Laboratory reported that a temperature increase caused by the failure of a refrigeration unit allowed cellulose nitrate stored inside to reach a potentially explosive state. The material safety data sheet for the chemical specified that it should be stored in a cool, dry place and the temperature should not exceed 60 degrees centigrade. Sometime between April 2 and April 9, both compressors for the refrigeration unit failed. The temperature in the refrigeration unit reached approximately 58 degrees centigrade before an alert researcher discovered the problem on April 9. Another researcher, who was aware of the danger of cellulose nitrate at elevated temperatures, called the laboratory fire department and restricted access to the unit. Hazardous material experts ordered evacuation of the area until explosives disposal personnel could transport the chemical off-site and neutralize it. Normally, failure of the two compressors would not be significant. However, because the increasing temperature in the unit was not recognized for a period of time, a potentially explosive condition resulted. (ORPS Report SAN--LBL-AFRD-1997-0002)

The refrigeration unit housed three, 1-liter containers of cellulose nitrate. Each container had slightly different concentrations in solution with 30 percent by weight isopropyl alcohol. Investigators determined that cellulose nitrate may become shock-sensitive if the alcohol is reduced by 5 percent or more. Elevated temperatures can expedite the loss of alcohol. Because the cellulose nitrate was safely neutralized before investigators could examine it, they were unable to determine if the chemical had actually reached an explosive condition.

The refrigeration unit is designed to operate at approximately four degrees centigrade. If there is a significant deviation in temperature, an alarm is supposed to sound locally and at a central alarm station. However, because the refrigeration unit is part of new construction, the alarm has not been wired to the central alarm station. When the local alarm sounded, someone silenced the alarm and failed to report it. Because the refrigeration unit is well insulated, the heat input from the failed compressor motors elevated the temperature inside to well above the ambient temperature of approximately 21 degrees centigrade.

The facility manager directed the workers to take the following corrective actions.

- Label the local alarms with placards indicating response instructions and an emergency contact.
- Wire the refrigeration unit alarm to the central alarm station.
- Ensure all personnel working in the vicinity of potentially hazardous chemicals have appropriate chemical hazard awareness training.

NFS reported the discovery of potential explosive mixtures because of liquid evaporation in Weekly Summaries 96-39 and 96-23. Weekly Summary 96-39 reported that a laboratory technician at Savannah River found picric acid in an explosive form. Picric acid is normally shipped in a solid form and can be safely handled and stored either as a solid or when it is dissolved in water. However, there is a strong potential for an explosion hazard if picric acid solutions become dry (through evaporation). (ORPS Report SR--WSRC-LTA-1996-0033) Weekly Summary 96-23 reported that a Rocky Flats building manager found metallic potassium stored in a petroleum base in an unsafe condition. Some of the oil may have evaporated, exposing 3/4 to 1 inch of potassium to air. Pure potassium metal in solid form is reactive and, through oxidation, creates a peroxide that is shock sensitive and may react violently with organic contaminates. The peroxide may also react explosively with metallic potassium. (ORPS Report RFO--KHLL-779OPS-1996-0045)

This event illustrates several lessons learned: (1) failed refrigeration units and cold rooms can reach temperatures well above ambient because of insulation and heat input from motors; (2) employees should consider alarms as valid until proven otherwise and should notify appropriate personnel; and (3) potentially hazardous chemicals must be carefully controlled and monitored to ensure they do not reach hazardous conditions. OSHA regulation 29 CFR 1910.119, *Process Safety Management of Highly Hazardous Chemicals*, states that hazard barriers and controls must be designed, implemented, and validated before initiating chemical processes. The regulation also states that these barriers and controls should be reviewed periodically and updated as necessary. OSHA regulation 29 CFR 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories*, provides direction on the use of chemicals, including signs and labels; spills and accidents; basic rules and procedures; and training and information.

KEYWORDS: alarm, explosives hazard, chemical

FUNCTIONAL AREAS: industrial safety, materials handling/storage